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NUMBER THEORY.

255. Proposed by FRANK IRWIN, University of California.

Given any arithmetical progression whose first term a and common difference d are relatively prime integers, and any finite set of positive integers $m_1, m_2, \cdots$ also relatively prime to d, it is required to determine an integer n such that the multiples of $m_1, m_2, \cdots$ may occupy the same positions in the series of natural numbers beginning with n as they do in the arithmetical progression. This is to say that if the kth, the (m_1+k)th, the $(2m_1+k)$th, $\cdots$ terms of the progression are divisible by m_1, so also will be the kth, the (m_1+k)th, the $(2m_1+k)$th, $\cdots$ terms of the series $n, n+1, n+2, \cdots$, etc. Show that n may be determined as the solution of a congruence $An+B\equiv 0 \pmod{C}$, whose coefficients, A, B, are constants independent of the number and value of the m's.

256. Proposed by FRANK IRWIN, University of California.

Let p be an odd prime, and let the notation $1/k$ stand for the solution of $kx\equiv 1 \pmod{p}$. Then show that if the sum of the numbers

$$1, \frac{1}{2}, \frac{1}{3}, \cdots, \frac{1}{(p-1)/2}$$

be congruent to zero (mod p)—should that be possible—the same is true for the sum of their products two at a time, as well as four at a time.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

A solution of 450 was received from G. Y. SOSNOW and one of 454 from J. J. GINSBURG which have not been acknowledged.

458. Proposed by CLIFFORD N. MILLS, Brookings, South Dakota.

Show that n terms of the series $1+3+4+6+7+9+10+\cdots$ is $\frac{1}{4}(n+1)(3n-1)$ when n is odd, and $\frac{n}{2}\left(\frac{3n}{2}+1\right)$ when n is even.

SOLUTION BY GEO. W. HARTWELL, Hamline University.

This series is a combination of two arithmetical progressions $3+6+9+\cdots$ and $1+4+7+10+\cdots$.

When n is even, the first becomes

$$3+6+9+\cdots+\frac{3}{2}n=\frac{n}{4}\left(\frac{3}{2}n+3\right)$$

and the second,

$$1+4+7+10+\cdots+\left(\frac{3}{2}n-2\right)=\frac{n}{4}\left(\frac{3}{2}n-1\right).$$

The sum of these two is

$$\frac{n}{4}\left(\frac{3}{2}n+3\right)+\frac{n}{4}\left(\frac{3}{2}n-1\right)=\frac{n}{2}\left(\frac{3}{2}n+1\right).$$

When n is odd, the first becomes

$$3+6+9+\cdots+\frac{3}{2}(n-1)=\frac{n-1}{4}\left(\frac{3n}{2}+\frac{3}{2}\right)$$

and the second,

$$1+4+7+10+\cdots+\left(\frac{3n}{2}-\frac{1}{2}\right)=\frac{n+1}{4}\left(\frac{3n}{2}+\frac{1}{2}\right).$$

The sum of these two is

$$\frac{n-1}{4}\left(\frac{3(n+1)}{2}\right)+\frac{n+1}{4}\left(\frac{3n+1}{2}\right)=\frac{1}{4}\left(\frac{3n^2}{2}-\frac{3}{2}+\frac{3n^2}{2}+2n+\frac{1}{2}\right)$$

$$=\frac{1}{4}(3n^2+2n-1)=\frac{1}{4}(n+1)(3n-1).$$